Malnad College of Engineering
An Autonomous Institution
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Team Flash

Crowd behaviour analysis using Finite element method for surveillance

Track: Innovation Challenge

Innovative Solutions Based on UN's SDG - without Prototype

GOAL 11

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Problem Statement:

In high-density public areas, detecting abnormal crowd behaviour in real-time is critical for ensuring public safety and preventing incidents like stampedes or riots. Existing surveillance systems primarily rely on manual monitoring, which are often insufficient for understanding complex human interactions in dynamic environments. There is a lack of intelligent systems that can accurately model and analyse crowd movement patterns under varying conditions.

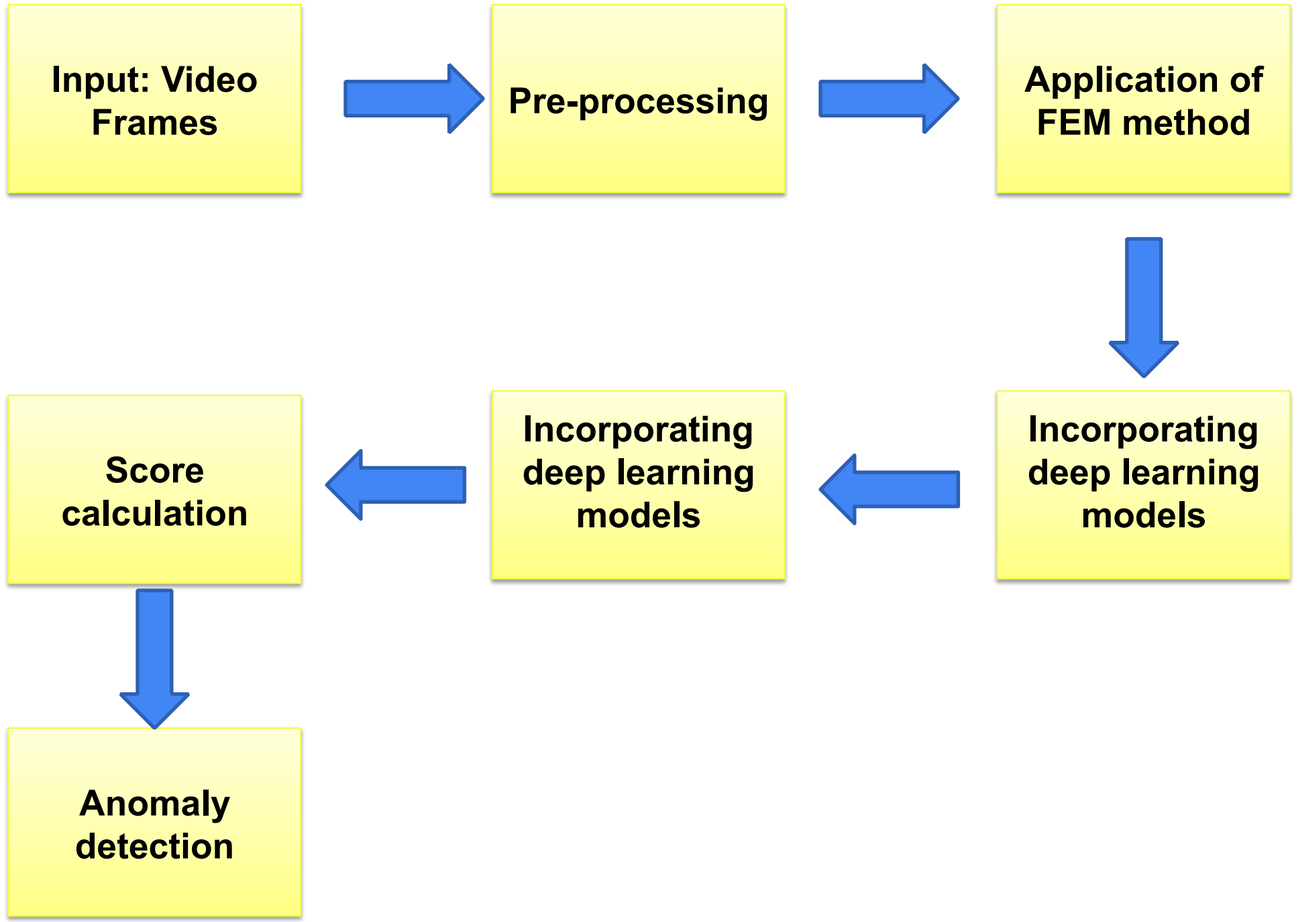
Introduction:

- Public safety in crowded scene is a concern in places like malls, stations, stadiums, and public gatherings.
- Traditional surveillance often relies on manual monitoring which are prone to delays and human error.
- There is a need for intelligent systems that can understand complex crowd behaviours in real-time.
- Finite Element Method (FEM) offers a new way to model human movement by treating individuals as interacting elements.
- This project aims to detect abnormal crowd patterns using FEM and video analysis to support smarter, proactive surveillance.

Research Survey:

Author(s)	Year	Title	Uses	Drawbacks
M. Bouzouina et al.	2021	Implementation of a Behavioral Analysis Method of Crowd Movement in the Service of Video Surveillance	Real-time crowd monitoring using video; improves alert systems	Depends on video quality; lacks predictive modeling
Z. Khan et al.	2020	Revisiting Crowd Behaviour Analysis Through Deep Learning	Uses deep learning for automatic detection of abnormal crowd behavior	Requires large annotated datasets; lacks interpretability
S. Piciarelli et al.	2022	Dominant Motion Pattern Recognition at the Pixel Level	Pixel-wise crowd motion tracking for pattern recognition	High computational load; may miss individual-level analysis
L. A. Kurakin et al.	2020	Mathematical Models and Methods for Crowd Dynamics Control	Uses FEM and other models to simulate crowd dynamics and suggest control strategies	Focused more on modeling, less on real-time implementation
J. Li and Y. Zhang	2021	Multi-Person Tracking and Crowd Behavior Detection via Particles	Multi-object tracking and crowd analysis using particle filters	Accuracy decreases in dense crowds
D. Kaminska and J. Nowak	2011	Behavior Analysis and Dynamic Crowd Management in Video Surveillance System	Uses video analysis for detecting door-blocking and managing flow	Limited to static camera positions; lacks adaptability

Proposed Solution:



ADVANTAGES	DISADVANTAGES
Real-time analysis	High computational cost
Early detection of abnormal crowd behaviour	Sensitive to environmental changes
Scalability and interpretability	Difficult to scale instantly
Can be trained over time	

Conclusion:

- This project presents a fresh way to improve crowd surveillance by combining video analysis with the Finite Element Method.
- By simulating how people move and interact in crowded spaces, it helps detect unusual or risky behaviour before it turns into a serious problem.
- Although the system may need high processing power, it has the potential to make public spaces much safer through smarter and faster decision-making.

References:

1. M. Bouzouina et al., *Implementation of a Behavioral Analysis Method of Crowd Movement in the Service of Video Surveillance*, 2021.
2. Z. Khan et al., *Revisiting Crowd Behaviour Analysis Through Deep Learning*, 2020.
3. S. Piciarelli et al., *A New Approach to Dominant Motion Pattern Recognition at the Pixel Level*, 2022..
4. L. A. Kurakin et al., *Mathematical Models and Methods for Crowd Dynamics Control*, 2020.
5. J. Li and Y. Zhang, *Multi-Person Tracking and Crowd Behavior Detection via Particles*, 2021.
6. D. Kaminska and J. Nowak, *Behavior Analysis and Dynamic Crowd Management in Video Surveillance System*, 2011.

Thank You